In the Specification

Kindly replace paragraphs [0001] through [0022] with the following:

Related Application

This is a §371 of International Application No. PCT/FR2005/000428, with an international filing date of February 23, 2005 (WO 2005/091104 A2, published September 29, 2005), which is based on French Patent Application No. 04/50329, filed February 23, 2004.

Technical Field

The ~~present~~ invention relates to ~~the area of~~ musical controllers. ~~The present invention relates more,~~ particularly to an ~~man-machine~~ interface permitting, e.g., the control of music software or of a controller by a multi-contact tactile screen with the manipulation of virtual objects.

Background

~~The prior art already contains manual~~Manual-type software controllers are known. They ~~are~~include, e.g., potentiometers that can be manipulated by the user in the form of a console and control the different functions of music software. Such a console ~~forms, e.g., the subject matter of PCT application~~is disclosed in WO 01/69399.

~~The~~One disadvantage of this type of controller is that they are not very ergonomic for an efficient manipulation of software. ~~The solution proposed by the present invention is~~One thought has been to implement a tactile screen for the manipulation of and the access to software functions.

In the area of tactile controllers ~~the prior art already contains in PCT application,~~ WO 03/041006 ~~or~~and US 6,570,078 disclose musical controllers with tactile control on a matrix sensor. The technologies described therein ~~these documents~~ permit [[a]]tactile control of the multi-contact type in which all the fingers can intervene for the control of software.

However, ~~these documents~~those publications do not ~~propose~~contemplate a visual return of the manipulations since the different matrix sensors are of the opaque type.

~~The prior art contains in American patent application~~ US 2002/005108 ~~(Lester Franck Ludwig) "Tactile, Visual and Array Controllers for Real-Time Control of Music Signal Processing, Mixing, Video and Lighting"~~discloses a system and a process for controlling in real time signal processors, synthesizers, musical instruments, MIDI processors, lights, video, and special effects during presentations, recordings or in compositional environments using images derived from tactile sensors, from matrices of pressure sensors, from matrices of optical transducers, from matrices of chemical sensors, matrices of body sensors and from digital processes. ~~The invention of this American patent application~~That system furnishes touchpads, matrices of pressure sensors and matrices of body sensors as interfaces of tactile control, video cameras and matrices of light sensors such as optical transducers, matrices of chemical sensors and of other apparatuses for generating digital images from processes on computers or from digital simulations. The tactile transducers can be arranged on the keys of conventional instruments, ~~be~~ attached to existing instruments or also be used to create new instruments or new controllers. The matrices of chemical sensors and the other apparatuses for generating digital images from computer processes or from digital simulations can be used to observe or simulate natural physical phenomena such as environmental conditions or self-organizing process behaviors. ~~Matrices of scalars~~Scalar matrices or ~~of~~ vectors are processed ~~in order~~ to extract pattern limits, geometric properties of pixels within limits (geometric center, weighted moments, etc.) and information derived from a higher level (direction of rotation, segmented regions, pattern classification, syntax, grammars, sequences, etc.) that are used to create control signals to external video and visual equipment and for control or even algorithms. ~~This invention~~It also ~~allows~~provides MIDI and non-MIDI control signals ~~to be furnished~~.

~~This American patent application~~It does not ~~propose~~contemplate a visual return of manipulations. ~~This American patent application~~ and does not mention a command law. Finally, ~~this patent application~~it does not ~~propose~~contemplate technical solution[[s]] to the masking phenomena that intervene when several figures are aligned or placed in an orthogonal manner on the sensor. The resolution of these problems is indispensable for realizing a multi-contact tactile sensor.

~~The prior art also contains in American patent~~ US 5,027,689 ~~(Yamaha) "*Musical Tone Generating Apparatus*"~~discloses an apparatus for generating musical sounds. ~~This~~That apparatus comprises a device for generating positional information for generating information about the position of musical instruments (PS) as values of plane coordinates. This information (PS) is stored in a memory device or determined in a selective manner by a manual operation. The apparatus also comprises a device for the conversion of information for converting the information (PS) into information for controlling parameters of musical sounds (PD). This PD control information controls the source signals of musical sounds (S11, S12 and S13) for generating a sound field corresponding to the position of musical instruments arranged on a stage. This allows an operator to verify the positions of musical instruments on a stage, thus supplying the sensation of being in a true live performance.

~~This American patent~~It mentions a multi-contact, but it is only two contacts on an axis and not in Cartesian coordinates. The apparatus ~~of this American patent~~ only functions linearly for the multipoint option and does not allow tracking (following of trajectory). Moreover, the apparatus ~~of this American patient~~ requires a plurality of sensors specific to each of the instruments ~~whereas the present invention relates to a generic sensor~~.

~~The prior art or also contains~~US 5,559,301 discloses a solution of the musical controller type in the form of a tactile screen with visual return of the manipulated objects ~~by US patent 5, 559, 301~~.

However, ~~this patent~~it describes predefined objects (essentially of the sliders type and circular potentiometer type). These object types are ~~rather~~ limiting and can prove to be not very ergonomic for special manipulations. Moreover, the acquisition mode described ~~in this patent~~ is not in real time. In fact, an icon must first be activated by a first contact with a finger, then the manipulated object, and the values are only updated after the icon has been released. ~~This solution~~That system does not allow [[a]]management in real time of the parameters associated with the object. Finally, the tactile sensor ~~used in this patent~~ is a "mono-contact" sensor that permits the acquisition, e.g., only for a single finger and therefore the control of a single object at a time. This characteristic is very limiting for an efficient manipulation of objects.

Summary

This invention relates to a process for controlling computerized equipment with a device including a multi-contact bidimensional sensor that acquires tactile information and a calculator that generates command signals as a function of the tactile information, including generating graphical objects on a screen placed under a transparent multi-contact tactile sensor, each graphical object associated with at least one specific processing rule such that the sensor delivers during each acquisition phase a plurality of tactile information, and each piece of the tactile information forms an object of a specific processing determined by its localization relative to a position of one of the graphical objects.

This invention also relates to a device for controlling computerized equipment including a multi-contact bidimensional sensor for acquisition of tactile information, a viewing screen arranged under the bidimensional tactile sensor, a memory for recording graphical objects that are each associated with at least one processing rule, and a local calculator that analyzes positions of acquired

tactile information and applies a processing rule as a function of the position relative to the position of the graphical objects.

Brief Description of the Drawings

The disclosure will be better understood with the aid of the following description given below solely by way of explanation of a selected, representative example with reference made to the attached figures in which:

Fig. 1A is a functional diagram of a controller;

Fig. 1B represents the structure of the controller associated with the functional diagram;

Fig. 1C represents the functional diagram of the different stages of the processes for the acquisition of data coming from the sensor, of the creation of cursors associated with the different fingers, of the interaction with the graphical objects and of the generation of control messages;

Fig. 2A is a description of the tactile matrix sensor;

Fig. 2B describes the first stage of the scanning functioning of the sensor in order to obtain the multi-contact information;

Figs. 2C, 2E and 2F explain the resolution of problems of orthogonality;

Fig. 2D is a functional diagram of the capture interface;

Figs. 3A to 3F are diagrams explaining the stages for the creation of cursors, filtering, calculation of barycenter, mapping and of the control of graphical objects;

Figs. 4 and 5 represent different examples of graphical objects;

Figs. 6 to 10 represent different examples of combinations of graphical objects on the controller; and

Fig. 11 illustrates the network use of the controller associated with the computer of the user.

Detailed Description

~~In all the following the~~The term "multi-contact" defines a tactile sensor that allows ~~the~~ acquisition of contact zones of several fingers at a time in contrast to "mono-contact" sensors that only allow ~~the~~ acquisition for a single finger or for a stylus as, e.g., in ~~the preceding patent~~ US 5, 559, 301.

~~The present invention has the problem of rectifying the disadvantages of the prior art by proposing~~We provide a screen for multi-contact tactile musical control with visual return of the different actions of the user on parameterable objects.

~~In order to do this the present invention is of the type described above and is remarkable in its broadest meaning in that it concerns~~We also provide a process for ~~the control of~~controlling computerized equipment ~~by~~with a device comprising a multi-contact bidimensional sensor for the acquisition of tactile information as well as ~~comprises~~ calculating means generating command signals as a function of this tactile information, ~~characterized in that it comprises~~and a stage for ~~the generation of~~generating graphical objects on a screen placed under a transparent multi-contact tactile sensor, each of which graphical objects is associated with at least one specific processing law, ~~that~~wherein the sensor delivers during each acquisition phase a plurality of tactile information, and ~~that~~ each piece of ~~this~~the tactile information forms the object of a specific processing determined by its localization relative to the position of one of these graphical objects.

The ~~processings preferably~~process steps may comprise a bounding zone detection of the contact zone of an object with the tactile sensor.

The ~~processings advantageously~~process may also comprise a barycenter detection.

It ~~preferably~~may further comprise[[s]] stages for ~~the~~ refreshing ~~of~~ graphical objects as a function of the process~~ings~~ carried out during at least one previous acquisition stage.

~~According to an embodiment it~~The process may comprise[[s]] a stage for editing graphical objects ~~consisting~~ including generating a graphical representation from a library of graphical components and functions and ~~in~~ determining an associated processing law.

The acquisition frequency of the tactile information ~~is preferably~~may be greater than 50 Hz.

~~The present invention~~We also ~~concerns~~provide a device for ~~the control of~~controlling a computerized piece of equipment comprising a multi-contact bidimensional sensor for ~~the acquisition of~~acquiring tactile information, ~~characterized in that it furthermore comprises~~ a viewing screen arranged under the bidimensional tactile sensor, ~~as well as~~ a memory for recording graphical objects that are each associated with at least one processing law, and a local calculator for analyzing the position of acquired tactile information and ~~the~~ application of a processing law as a function of ~~this~~the position relative to the position of the graphical objects.

~~Moreover, it is preferably~~The device may be connected to a hub (multi-socket network) ~~for forming~~to form a network of controllers.

Kindly replace paragraphs [0024] through [0027] with the following:

Furthermore, ~~this~~the device ~~preferably~~may comprise[[s]] a network output suitable for receiving a network cable.

~~The invention will be better understood with the aid of the following description given below solely by way of explanation of an embodiment of the invention with reference made to the attached figures in which:~~

~~Figure 1A is a functional diagram of the controller in accordance with the invention.~~

~~Figure 1B represents the structure of the controller associated with the functional diagram of the invention.~~

~~Figure 1C represents the functional diagram of the different stages of the processes for the acquisition of data coming from the sensor, of the creation of cursors associated with the different fingers, of the interaction with the graphical objects and of the generation of control messages.~~

~~Figure 2A is a description of the tactile matrix sensor.~~

~~Figure 2B describes the first stage of the scanning functioning of the sensor in order to obtain the multi-contact information.~~

~~Figures 2C, 2E and 2F explain the resolution of problems of orthogonality.~~

~~Figure 2D is a functional diagram of the capture interface.~~

~~The series of figures 3A to 3F explain the stages for the creation of cursors, filtering, calculation of barycenter, mapping and of the control of graphical objects.~~

~~Figures 4, 5 represent different examples of graphical objects.~~

~~Figures 6 to 10 represent different examples of combinations of graphical objects on the controller.~~

~~Figure 11 illustrates the network use of the controller associated with the computer of the user.~~

In ~~all of~~ the following description, the control is performed on a computerized piece of equipment that can be, e.g., a music software, a controller, audiovisual equipment or multimedia equipment.

As ~~figures~~Figs. 1A, 1B and ~~more precisely~~ 2A illustrate, the first basic element ~~of the present invention~~ is the matrix sensor 101 necessary for ~~the~~ acquisition (multi-contact manipulations) with the aid of a capture interface 102. The sensor ~~can~~101 may be divided, if necessary, into several parts ~~in order~~ to accelerate ~~the~~ capture, with each part being scanned simultaneously.

Kindly replace paragraphs [0029] through [0034] with the following:

When the user removes ~~his~~the user's fingers from the sensor, the associated cursors are destroyed.

In this manner, the position and ~~the~~ development of several fingers are captured simultaneously on the sensor. This is a multi-contact capture that is quite innovative for this type of controller.

The sensor ~~used for the embodiment of the invention is~~may be a resistive tactile matrix tile of a known type.

Resistive tactile matrix tiles are composed of 2 superposed faces on which tracks of ITO (indium tin oxide), that is a translucent conductive material, are organized. The tracks are laid out in lines on the upper layer and in columns on the lower layer~~, forming~~ and form a matrix ~~(cf. Figure~~as shown in Fig. 2A~~)~~.

The two conductive layers are insulated from one another by spacing braces. The intersection of the line with the column forms a contact point. When a finger is placed on the tile, a column or columns situated on the upper layer are put in contact with a line or line situated on the lower layer, thus creating one or several contact points ~~(cf. Figure~~as shown in Fig. 2B~~)~~.

~~A variant of the invention advantageously consists in replacing~~It is possible to replace the braces by a transparent resistive material (e.g., a conductive polymer) whose resistance varies as a function of the pressure, which resistance drops if a sufficient pressure force is exerted. In this manner, it ~~would~~is also ~~be~~ possible to extract the pressure exerted on the surface by performing a resistance measurement at each line-column intersection.

Kindly replace paragraphs [0036] through [0040] with the following:

The state of the tile is measured at least 100 times per second, which tile can be divided into several zones ~~in order~~ to ~~perorm~~perform a parallel processing on these zones.

Thus, ~~according to the invention~~ the sampling frequency of the tile ~~is~~may be at least 100 Hz.

Another basic element is the electronic device for scanning the tactile tile that allows the simultaneous detection of several contact points on the matrix sensor. In fact, the known methods of acquisitions for this type of sensor[[s]] do not allow the detection of several simultaneous contact points.

The known methods ~~known in the past~~ do not allow the problems illustrated ~~by figure~~in Fig. 2C to be solved.

If a simultaneous measurement of all the lines is performed while feeding a column, problems of orthogonality arise. Contact point No. 1 will mask contact point No. 2. Likewise, if a line is measured when all the columns are fed, contact point No. 2 is masked by contact point No. 1. The solution ~~proposed~~ for ~~solving~~ this problem ~~consists~~is in performing a sequential scanning of the sensor.

Kindly replace paragraph [0042] with the following:

When one of the columns is placed under voltage, the others are in high impedance ~~in order~~ to prevent the propagation of current into the latter.

Kindly replace paragraphs [0047] through [0048] with the following:

As the goal is to form a multi-contact tile, the total scanning of the matrix is carried out at an elevated frequency ~~in order~~ to obtain the value of each of the intersection points of the tile several times per second.

The device permitting the acquisition of the tile data is illustrated in ~~figure~~Fig. 2D, representing the algorithm of the acquisition of a tile comprising 100 lines (L) and 135 columns (C).

Kindly replace paragraphs [0051] through [0061] with the following:

In ~~figures~~Figs. 2E and 2F, the cloud of points absorbs a large part of the electrical potential of the fed column. The potential measured at the isolated point is therefore too low to be detected.

~~The~~A solution to this problem ~~consists~~is in using a voltage comparator piloted digitally at the output of the line ~~in order~~ to determine whether the tension observed is sufficient for being considered as resulting from the action of a finger on the tactile tile. The reference value of the comparator (comparison threshold) is decremented at each line measure. Thus, the comparison values of the last lines are lower than those of the first lines, which allows the contact point located at the lower left or the upper right to be detected in the same manner.

Thus, e.g., ~~the~~a complete sampling of the tile is performed at least 100 times per second for the columns and the lines.

The data from capture interface 102 thus form an image representative of the totality of the sensor. This image is placed in memory so that a program can proceed to the filtering, the detection of the fingers and to the creation of the cursors~~. Refer for this effect to figure~~ as seen in Fig. 1.

The filtering phase illustrated by ~~figure~~Fig. 3B ~~consists in eliminating the~~eliminates noise that might be generated by the acquisition interface or the sensor itself. It is considered that only the clouds of several contact points can correspond to the pressure of a finger. Therefore, a bounding zone detection is carried out ~~in order~~ to eliminate isolated contact points.

The following stage ~~consists in associating~~associates a cursor with each support point (~~figure~~Fig. 3C). To this end, the barycenter of each bounding zone is calculated. When a finger is released, the corresponding cursor is freed.

The program executed locally by the main processor allows these cursors to be associated with graphical objects that are displayed on screen 105 ~~in order~~ to manipulate them. At the same time, the local program uses these cursors for generating control messages addressed to the host computer or the controlled apparatus.

Furthermore, the program comprises a simulator of the physical models allowing ~~the~~ modification of the interaction laws between the cursors and the graphical objects. Different physical models can be employed: spring-loaded system, vibration of a string, management of collisions, the law of gravity, electromagnetic field and the like.

The program considers the positioning of the cursors and on which graphical object each is located. A specific processing is supplied to the data coming from the sensor as a function of the object considered. For example, a pressure measurement (corresponding to a development of the spot made by the finger on the tactile tile in a short interval of time) can be interpreted. Other parameters can be deduced as a function of the nature of the object: the acceleration, speed, trajectories, etc. Algorithms of recognition of form can also be applied ~~in order~~ to differentiate different fingers.

The main program 103 also transmits the data to be displayed on screen 105 to graphical interface 104. Moreover, this graphical interface is constituted ~~by~~of a graphical processor. This graphical processor is, e.g., of a known type. The latter can be constituted ~~by~~of primitive graphical functions allowing, e.g., the displaying of bitmap, ~~of~~ fonts of polygons and ~~of~~ figures in 2 and 3 dimensions, ~~the~~ vectorial design, ~~the~~ antialiasing, ~~the~~ texture mapping, ~~the~~ transparency and ~~the~~ interpolation of colors.

~~In this presentation of the invention the~~The main program may also comprise[[s]] an analyzer of mathematical expressions that allows mathematical functions to be inputted and calculated in real

time. These functions allow the values of any variable to be modified. For example, the coordinates (x, y) of a cursor inside an object can be considered as two variables comprised between 0 and 1. The expression analyzer allows an expression of the type "x*1000+600" to be created ~~in order~~ to obtain a new variable whose value is comprised between 600 and 1600. The variable obtained allows the control, e.g., of the frequency of an oscillator comprised between 600 and 1600 hertz.

Kindly replace paragraph [0066] with the following:

It should be noted as illustrated in ~~figure~~Fig. 11 that the Ethernet connection offers the user the possibility, by using a simple hub (multi-socket network), of indefinitely expanding ~~his~~the control apparatus by constituting a network of controllers ~~in accordance with the invention~~.

Kindly replace paragraph [0069] with the following:

Finally, an interface editor 107 at the level of the computer of the user allows the interface, that is, the totality of the graphic objects displayed on screen 105, to be programmed in a graphical manner. ~~In this embodiment of the invention the~~The interfaces ~~are~~may themselves be organized in scenes, that are higher hierarchical structures. In fact, each scene comprises several interfaces. The user can interchange the interfaces with the aid of a button keyboard or a control pedal board connected to input-output port 109.

Kindly replace paragraph [0071] with the following:

The user has at ~~his~~the user's disposal, e.g., a library of parameterable graphical objects allowing the composition of different interfaces according to the application desired. ~~Figures~~Figs. 4 and 5 represent different graphical objects placed at the disposition of the user.

Kindly replace paragraph [0074] with the following:

In addition to the positioning of graphical objects on the main window, other secondary windows allow the regulation of different parameters inherent in the objects (graphical properties,

physical behavior). For example, a button 402 can also act as a switch or as a trigger. In the case of the trigger mode, a pressure measurement can optionally be performed. Another example of a parameterable object is area 2D (503, 544) of which the principle ~~consists~~ includes moving pawns inside a delimited zone. The number of pawns present in area 2D is a parameterable option. The area can be configured in uniplan mode, a mode in which the pawns enter into collision with each other, or multi-plan, a mode in which the pawns are placed on distinct superposed planes. Physical parameters can also be configured: the coefficient of friction of the pawns on the plane, the rebound and the attraction of the pawns on the edges and among themselves.

Kindly replace paragraph [0082] with the following:

Another variant of area 2D ~~consists~~ includes applying a physical law of the "spring-loaded" type. A virtual rubber band is stretched between each cursor and each pawn. The user can modify the behavior of this object by configuring the friction and the interpolation factor. These properties can also be modified in real time with the aid of other objects.

Kindly replace paragraphs [0084] through [0090] with the following:

A visualization of different examples of interfaces uniting different types of objects is illustrated by ~~figures~~Figs. 6 to 9, in which several objects described above can be observed.

Fig~~ure~~. 6 shows an arrangement of 6 areas 2D (601) containing 1 pawn each. This interface could control, e.g., six different filters assigned to one or several sound sources. In this instance, the abscissa movement of each pawn in each zone controls the frequency of the filter whereas the ordinate movement controls the quality factor or the width of the filter band.

Fig~~ure~~. 7 shows an example of the control of a synthesizer or of a sampler of a known type. The interface is composed by a tempered keyboard 704 controlling the pitch of the sounds, by a group of four vertical potentiometers 703 allowing the control, e.g., of its dynamic envelope (attack

time, hold level, release time). An area 2D (701) containing 3 pawns allows the control, e.g., of effects applied to the sound (reverberation, echo, filters). A matrix of 16 buttons 792 can, e.g., release 16 different recorded musical sequences or also call up 16 prerecorded configurations of the previously described controls.

Another example ~~of an application of the invention~~ is illustrated by ~~figure~~Fig. 8 showing the control of a device for the broadcasting of different sound sources into space on a device constituted by several loudspeakers. In this configuration an area 2D (801) representing the broadcasting space contains 4 pawns 801 corresponding to four sound sources. Area 2D also contains 5 icons 802 representing the position of five loudspeakers. The level and/or the phase of each sound source relative to each enclosed space is regulated by moving the different pawns 802, which determines its emplacement in the space. Moreover, a group of four linear potentiometers 803 allows the relative level of each source to be regulated. A unit of four buttons 804 allows each sound source to be activated or deactivated.

Another example is illustrated ~~by figure~~in Fig. 9 that shows the control of a synthesizer or a sound generator according to a configuration different ~~than~~from that shown ~~by figure~~in Fig. 7. Here, the frequency of the sound generator is controlled by four virtual strings 903. The initial tension (the pitch) of each string can itself be controlled, e.g., by a linear potentiometer 902. An area 2D 10, e.g., control other parameters of the sound generator such as the output level, the sound quality, the panning, etc.

Fig~~ure~~. 10 shows the control of equipment for audio and/or video editing of a known type. A serrated wheel 1001 allows the rate of reading the audio and/or video sources to be controlled. Status display object 1002 allows the positioning of the reading to be represented according to a

format (hour, minute, second, image) of a known type. A set of buttons 1003 allows access to the functions of reading and editing of the controlled apparatus.

The ~~invention was~~devices and methods described above are by way of example. It is understood that ~~an expert~~one skilled in the art is capable of realizing different variants of the ~~invention~~devices and methods without departing from the scope of the ~~patent~~appended claims.